

**RARITAN ARSENAL
UNEXPLODED ORDNANCE REMOVAL PROJECT
EDISON, NEW JERSEY**

by Robert Nore

The U.S. Army Corps of Engineers, Huntsville Division (CEHND), is the Mandatory Center of Expertise (MCX) and Design Center for ordnance and explosive waste (OEW) contamination at formerly used defense sites under the Defense Environmental Restoration Program (DERP-FUDS). The former Raritan Arsenal is one of more than 1100 sites on the FUDS inventory which are potentially contaminated with unexploded ordnance. Huntsville Division began an Interim Removal Action at Raritan in April 1991. This paper is a discussion of the site history, community relations, coordination, environmental constraints, contracting, current status, and lessons learned during the study, design and execution phases of the project.

SITE HISTORY

The site consists of 3200 acres located on the banks of the Raritan River in Edison, NJ, approximately 20 miles southwest of Manhattan, NY. Raritan Arsenal was established in 1917 as a storage depot for shipments overseas. Because of its strategic location it was established as a permanent ordnance depot shortly after World War I. Depot operations at that time consisted mainly of vehicle storage and ammunition receiving, storage, shipping, transfer, and re-packing. Types of ordnance handled included 37 mm and 40 mm projectiles, fuzes, pyrotechnics, grenades, training rounds, and TNT. French and British ordnance is also known to have been stored there. From 1919 until 1941, the Ordnance Specialist School was located there. Several accidental explosions occurred during the period from 1919 through World War II in magazine buildings and outdoor storage areas, scattering OEW over large areas.

During World War II, storage facilities, shipping facilities and ammunition igloos were greatly expanded. A products division and field service ammunition school were also added to the Arsenal mission. In 1951 the Provisional Unit Training Center was added to train, supply and activate Explosive Ordnance Disposal units. This center was deactivated in 1952, however.

Many of the arsenal's activities were phased out in the decade of the 1950's. Some waste materials including ordnance and chemical agents were routinely destroyed by burial or by burning in chambers or pits. In 1962 the government declared the site excess to the Army's needs. Final phase-out began in 1962 and lasted until 1964, when Raritan Arsenal was turned over to General Services Administration (GSA) for disposal. Decontamination of the site was performed in 1963 by Raritan Arsenal personnel, and later by Letterkenny Army Depot and the Army Materiel Command Safety Office. An archives search conducted by LEAD in 1963 designated 17 areas as potentially

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contaminated and recommended restrictions on future land use. The property when sold by GSA contained the recommended restrictions.

The site is now the home of Middlesex County College, Thomas Edison County Park, Environmental Protection Agency offices, and Raritan Center, New Jersey's largest industrial park. The northern half of the site has been developed extensively. The southern half is primarily wetlands, with limited development since the arsenal closed.

INTERIM REMOVAL ACTION

In 1985, the former Raritan Arsenal was one of the first sites to receive a preliminary assessment under DERP-FUDS. When the potential for ordnance was found, the site was programmed for a large-scale site investigation. The scope of work was developed at CEHND, coordinated with USEPA and New Jersey Department of Environmental Protection (NJDEP), and tasked to U.S. Army Engineer District, Kansas City (CEMRK). In 1987 the site investigation was begun with the intent of confirming or denying both hazardous and toxic waste and ordnance contamination. The study included installation of groundwater monitoring wells, groundwater sampling, soil sampling, and surface and subsurface surveys for ordnance. The final report released in 1990 confirmed the presence of ordnance and chemical contamination of soil and groundwater.

As the MCX and Design Center for OEW cleanups, CEHND determined that the best initial approach to remedial action was to schedule an interim removal action to remove the imminent hazards, and a feasibility study to determine the appropriate approach to the long-term cleanup of the lesser hazards. In 1990 these two projects were added to the DERP-FUDS Workplan for FY91. CEHND and CEMRK held a joint public meeting in August 1990 to discuss CEHND plans for ordnance actions and the CEMRK scheduled Remedial Investigation/Feasibility Study (RI/FS) for hazardous and toxic waste.

Funds were received in February 1991 and three delivery orders were immediately issued to IT Corporation for ordnance removal actions at Area 16, Area 4, and Areas 1, 2, and 3 (see Figure 1), at a total estimated cost of \$320,000. During preparation of the contractor's work plans, discussions were held with NJDEP in April 1991 on the issue of permits. We were successful in convincing NJDEP that the on-site removal actions we were conducting are specifically exempted from the environmental permitting process. We also had extensive negotiations with the property owners during April and into May in order to gain rights of entry (ROE). In early May we issued a fourth delivery order for \$120,000 to clear Areas 6 through 10, 17, and a spoil area across the Raritan River, and to perform on-site demolition of all ordnance found. We also included a requirement to check out an eyewitness account of buried ammunition at Building 118 on Middlesex County Campus.

On 7 May 1991, we held a public meeting to inform the public of our clearance plans. We began the next day with a clearance

at Area 1 (owned by USEPA), since we did not have an executed ROE document for the Raritan Center property. This site, consisting of nearly 1/2 acre, was used as a former demolition ground from World War I to the early 1930s. The clearance of Area 1 was completed that same day, and revealed no evidence of OEW. We began on 10 May 1991 the clearance at the site for Building 643, a former ammunition magazine in Area 16, expecting to find maybe 3,000 unfired, fused 37 mm projectiles. Our clearance operation consisted of excavation of a 150-foot square area with a trackhoe, screening out of ordnance on a mechanical shaker, and storing the ordnance in lockboxes until they could be destroyed. The effort was far greater than previously estimated, due to several factors. First, we expected to find only several thousand 37 mm projectiles, and ended up with over 29,000 rounds. At one point excavation reached 15 feet in depth. This large find required that we field an additional work team to perform full-time demolition, and develop a much larger storage capacity. After a vandalism incident near our worksite, we were required by Edison Township to ensure that the site was guarded at all times. We also found another 1100 37 mm projectiles at an adjacent site (Building 644).

Although Areas 2 and 3 were cleared of brush in May, we delayed an ordnance sweep so that we could concentrate our efforts on Area 16 and on Middlesex College Campus (MCC). Our investigation of the eye-witness account had led in early June to the discovery of a number of booster adapters near Building 118, a former hospital, and now known as North Hall. This discovery came at a very unfortunate time, since the MCC had scheduled a huge festival for the last two weeks of June. Additional funds were requested and received from HQUSACE, since by now we had made the news headlines and incurred the intense interest of U.S. Congressman Bernard Dwyer. We fenced off the building site and began a clearance effort over a two-acre area that we hoped would last only two weeks. However, we located a burial trench about 40 feet wide by 200 feet long by 5 feet deep, loaded with booster adapters, and did not complete clearance at this site until nearly a year later, on 14 April 1992.

The operation at Building 118 consisted of using a backhoe to expose the trench, and then removing the adapters with hand tools. Since the adapters could contain about four ounces of a TNT/Tetryl mixture and had been buried at least 72 years, extreme care was necessary. MCC campus police and a private security servied were hired to escort ordnance from the campus and to provide around the clock security. Ordnance was hauled by pickup truck through the campus and park during the least active hours of the day, to be stored in the lockboxes at Area 16. Unusual problems were encountered and overcome at this site. Tree roots for several old elm trees had grown around individual adapters. The trees had to be cut down, and the roots were taken to the demolition area for destruction. Adapters had been used for aggregate for a concrete duct bank. The concrete was broken up and hauled to the demolition area for destruction. We discovered an abandoned underground storage tank which had to be disposed of in accordance with NJDEP requirements. We had to move another

underground fuel tank being used by MCC, and are still involved in negotiations over whether we should be required to pay for replacement or upgrade of their tank to meet NJDEP requirements. A driveway had to be destroyed to gain access to the adapters buried underneath, and then replaced. None of these costs had been programmed, and each new problem required new modifications and new money from HQUSACE. We removed a total of 84,000 booster adapters from the Building 118 excavation.

Area 4 is a two-acre area which was formerly a salvage and melt-out area for demilitarization of ammunition ranging from 75mm to 12-inch projectiles. The USEPA, alarmed by the findings of the 1990 Site Investigation, had constructed a chain-link fence around Areas 4 and 5 in 1990. Action at Area 4 was delayed until September 25, 1991, until our actions were nearly complete at Area 16. After performing a surface clearance and brush clearance, a decontamination station was set up to treat all men and equipment leaving the area. Grid search lanes were set up and a subsurface clearance commenced. The contractor began a systematic excavation and screening operation in order to separate bulk TNT as small as 1/2-inch from the soil. Equipment consisted of a trackhoe, front-end loader, conveyor belt and mechanical sifter. This activity lasted until 20 March 1992 and resulted in the recovery and destruction of over six tons of bulk TNT, a 20-lb British bomb (inert), 21 75-mm projectiles, and a dozen other miscellaneous ordnance items. Excavation was to a depth of six feet in places.

Area 10, now known as Thomas Edison County Park, was once used for ammunition storage and depriming of cartridge cases. We concentrated on a 10-acre area where a magazine explosion had scattered French rifle grenades. Although we know the site was swept for ordnance before the property was sold, it became a high priority for clearance due to the public's perception of a hazard. Clearance began in October 1991 and is 50 percent complete. Clearance in this area was seriously hampered by widespread occurrence of magnetic rock. Approximately 35 French rifle grenades have been found, anywhere from ground level to two feet below ground. Security was provided by Edison Park Police until a chain link fence was erected around the most active area.

Area 17, a two-acre area once used for property disposal and salvage storage, is located on MCC campus. Our investigation consisted of a subsurface sweep with ordnance locators, mapping of all contacts, and excavating in selected areas based on concentrations of ring-offs. No ordnance was found.

On-site demolition was conducted at Area 12, which is remote from populated areas and had been used in the past as a bomb disposal training area. At the start of our clearance we had the support of the 54th Explosive Ordnance Disposal (EOD) Unit from Fort Monmouth, New Jersey in conducting demolition operations. Initial blasting was conducted by placing the ordnance in one-foot deep trenches, and with no overburden. Noise proved to be such a nuisance to people living across the Raritan River that we asked the 54th to postpone "production blasting" and instead conduct test blasting. We called in a team from Corps of Engineers Waterways Experiment Station in mid-June to measure

seismic and noise impacts of our demolition operation. They determined that overpressure and seismic effects were not significant, but that noise levels were in the "nuisance" range. We asked 54th EOD to cover their shots with two feet of sand. The tests showed good noise reduction, so we went back to "production".

The 54th EOD Detachment had been conducting the demolition to the extent that their mission priorities allowed. However, the amount of ordnance recovered from Area 16 in May and June was much greater than anticipated. A large backlog of 37 mm projectiles had accumulated (23,000 by the end of June). When we found that the 54th could conduct demolition for only two days in July because of mission training, we decided on 1 July 1991 to turn demolition duties over to the contractor. After experimenting with different configurations and different explosives, the contractor settled down to a destruction rate of about 2000 projectiles or booster adapters per day.

The Edison Volunteer Fire Department had been asked by the 54th EOD to have an engine standing by in case of fires or need of medical assistance. As the demolition operation expanded, EFD decided that they could no longer afford to finance such volunteer support. Although we argued that we could provide equivalent safety measures under our own power, EFD insisted that they must be involved, and we must pay them. We authorized our contractor to pay them for an engine and three firemen to support the demolition effort. We were also required to have a member of the Edison Police Department's Emergency Management office on hand for all shots.

Our interim removal actions so far have addressed only a few of the suspect areas, and much remains to be done. The dredge spoil area across the river is known to contain French rifle grenades. CEMRK has discovered hard evidence of ordnance while drilling monitoring wells in Area 11 and Area 3. Sampling has yet to be accomplished in several other areas.

FEASIBILITY STUDIES

It was always our intent to conduct a feasibility study for the entire former arsenal, but the unexpected growth of the clearance forced us to use the FY91 study funds for clearance efforts. Funds for study were again programmed for FY92, and were again side-tracked to studies for Area 5, a former mustard agent disposal area. We have been engaged for the last two years in efforts to establish chemical agent disposal procedures to support the DERP-FUDS program. Area 5 at Raritan is the pilot project for the new program, which has resulted in the formation of a new agency, U.S. Army Chemical Munitions Destruction Agency (USACMDA). We will start in September a characterization of Area 5 as the beginning of a full scale Remedial Investigation/Feasibility Study (RI/FS). This initial characterization is limited to non-intrusive studies only, until USACMDA solves the problem of finding acceptable disposal methods for any chemical warfare material that we might find.

At Congressman Dwyer's insistence, we found emergency funds

and awarded a contract for an archives search to Metcalf & Eddy on 8 July. We received a final report for the MCC and park on 30 August and for the remainder of the arsenal on 30 September.

This effort involved in-depth study of archives and interviews of former employees to determine any other possible ordnance burial areas. Two new small areas were located on MCC campus that may be worth further investigation.

Current studies at sites other than Area 5 consist of an in-house Engineering Evaluation/Cost Analysis (EECA) for a limited number of ordnance areas to determine the most economical approach to remediation. This EECA is in reality a miniature RI/FS, and will be expanded next year to cover all ordnance areas. In this study, we use our cleanup contractor to sweep the test areas with a magnetometer and map the underground contacts. We use that data to decide whether a clearance is even necessary, and if so, how best to accomplish the cleanup.

GOVERNMENT COORDINATION

Coordination among government agencies is highly complicated, and is spelled out in the Project Management Plan developed by U.S. Army Engineer District, New York (CENAN). Their parent division, the North Atlantic Division, assigned them overall project management responsibilities, in order to ensure that the COE effort is coordinated and that the public perceives the COE as one entity.

CEHND's relationship with CENAN is spelled out in a Memorandum of Understanding signed 13 December 1992, which gives CEHND management responsibilities for planning, design and execution of ordnance studies and removals. CENAN is responsible for public affairs, right of entry, and providing a Contracting Officer's Representative (COR) to oversee the sitework. CEHND is responsible for providing quality assurance for the ordnance cleanup, resolving permit issues, and funding for the ordnance projects.

CEMRK is responsible for conducting the RI/FS for hazardous and toxic waste at Raritan. Since this effort involves drilling of monitoring wells and taking soil samples in potential ordnance contamination areas, we review their work plans to ensure ordnance safety. Some of the areas at Raritan are a combination of ordnance and hazardous waste, so we must coordinate with CEMRK in determining how best to remove the ordnance hazard so that Kansas City can efficiently conduct their actions. We must also jointly plan public meetings and participate in Technical Review Committee meetings.

U.S. Army Engineer District, Omaha is responsible for management of preplaced quick response actions at hazardous waste sites. They must coordinate with CEHND to ensure ordnance safety for their activities. We provided ordnance support for a recent Omaha cleanup at a pond on the USEPA property at Raritan.

USACMDA was formed earlier this year to head the programmatic efforts involved in cleanups of Chemical Warfare Material (CWM) sites. They must develop technologies for monitoring, on-site treatment, transportation and storage of CWM

at Raritan and many other suspect CWM sites. We will be responsible for uncovering the CWM and treating in place if necessary. There are many areas where our efforts will interface with those of USACMDA.

USEPA is interested in our efforts for several reasons. They own a portion of the property and have been involved for many years in guiding the hazardous waste investigations. They are under severe criticism for not getting the former arsenal on the National Priority List, and are sensitive to any kind of publicity. We invite USEPA and NJDEP to review and comment on our work plans, although we make it clear that DOD is the response authority for ordnance actions.

COMMUNITY RELATIONS

Since Spring of 1990 the media, local citizens, special interest groups, local officials, and U.S Congressmen have been keenly interested in COE actions at Raritan. This attention springs from a variety of issues, among them a proposal by the owners of Raritan Center for a \$1 billion waterfront development. The proposed Rivertown project would include housing, office, retail and warehouse space, and received approval in 1988 from the Edison Planning Board. Opposition is rooted in the certain destruction of a large wetlands area. Another issue affecting public interest is USEPA's proposed use of their property on the former arsenal as a laboratory to test new methods for cleaning up hazardous waste. USEPA had also considered siting a hazardous waste incinerator on their property, but abandoned the proposal after receiving very heated opposition from the public and media. Finally, local citizens are concerned about the potential health and safety effects posed by the hazardous waste and ordnance at the site.

When the COE began our studies, the media began to interview personnel from Kansas City and Huntsville Division, since at that time New York District personnel were not knowledgeable on the subjects of OEW or HTW. The press played COE personnel against each other, accused us of foot dragging, and damaged COE credibility. After that, we insisted that each COE organization speak only about its particular mission, and the credibility problem was resolved. Our approach to the cleanup was perceived by the public as fragmented, although in fact it was properly coordinated. When the first public meeting was held in August 1990, the special interest groups and politicians began to make their presence known. By the second public meeting in May 1991, the public reaction to the COE was much calmer. Congressional reaction to the media blitz, however, forced North Atlantic Division to assign control of all COE activities at Raritan to New York District. This action was to ensure that the COE response to inquiries was consistent and coordinated.

Other actions taken since then include the institution of weekly and sometimes daily press releases to all the local media and officials, and establishment of a Technical Review Committee. The TRC consists of twenty members representing the involved COE offices, USEPA, NJDEP, owners of the former arsenal, local

interest groups and Congressman Dwyer's chief aide. The TRC is very effective as a means of getting accurate information to the community and discussing problems as they arise.

LESSONS LEARNED

Many elements came together over the first year of activity at the former arsenal to put a great strain on our contracting ability. Frequent contract changes were necessary because of new discoveries in the field, new requirements for site security or fire support, and many other problems that were never foreseen. As the project expanded in scope and took on a more permanent nature, it also became necessary to provide more sophisticated field offices both for COE and contractor personnel.

We chose a Time and Materials delivery order contract with a \$5 million capacity and a one-year ordering limit. This type of contract lends itself very well to actions where the actual effort cannot be estimated with any degree of confidence. The prime contractor was IT Corporation and the subcontractor for ordnance was EOD Technology, Inc. This combination of a prime with good management experience and a subcontractor with a good track record in ordnance removal projects appeared to be ideal for our purposes.

Although we developed good working relationships with the IT program and project managers, COE and contractor perspectives sometimes led to confusion or misunderstandings.

Our orders for work were often based on funds available, and although we were only ordering a term of work, our objective was to complete an action during that term. The contractor after receiving an order would immediately prepare a request for modification that was their estimate of funds needed to complete the action based on their own estimates of unknown conditions. This request was sometimes a waste of time, since funds would not be available to complete the action.

The contractor initially assigned a project manager from their area office, which by coincidence is located at Raritan Center. This manager had experience in managing smaller projects, and that was fine from the COE perspective, since we initially anticipated spending less than \$500,000 over a three-month period. As the complexity grew, the reporting requirements grew, and it became obvious by October that a more sophisticated management team was needed. In December the contractor answered the COE request for a more experienced project manager. They also began new accounting procedures for tracking costs, since by December spending had reached nearly \$30,000 per day.

The contractor, with vast experience in hazardous waste remediation, was inclined to follow the lead of the regulatory agencies in preparing the design for a project. We found that we had to take a strong lead with the contractor and with NJDEP simply because our "no permits" policy was foreign to them. We had to prove to NJDEP that Department of Defense is the response authority for ordnance remediation, that ordnance is not hazardous waste, and that we are not required to obtain

environmental permits for our action at Raritan. This issue held up completion of our work plans for approximately one month. We were successful in convincing NJDEP that our policy was correct, but have found that we are faced with the general problem of educating the regulatory community each time we begin a project.

After fieldwork commenced, we assigned COR authority to a person from CENAN. This COR was also responsible to New York District for overall coordination of the hazardous waste and ordnance cleanups, and for carrying out any separate agendas that the District might have. Our contractor was sometimes caught between their need to satisfy our contractual requirements and New York District's separate agenda. We felt the need at times to reinforce to the Contractor and the COR their appropriate contract responsibilities.

Another problem we faced was the "deep pockets" syndrome. As stated before, we are still involved in negotiations with the owner of MCC regarding liability for replacement of an underground storage tank. The MCC used this tank for many years and should under DERP-FUDS policy be responsible for upkeep and eventual replacement. However, since the U.S. Government has plenty of money it is expected by many people to cover the costs.

CONCLUSION

Although we have been working at Raritan for well over a year and spent over \$5 million on removal of ordnance, our job appears to be only about 20 percent complete. For FY93 we have programmed \$3.4 million for cleanup costs and \$1.6 million for site characterizations.

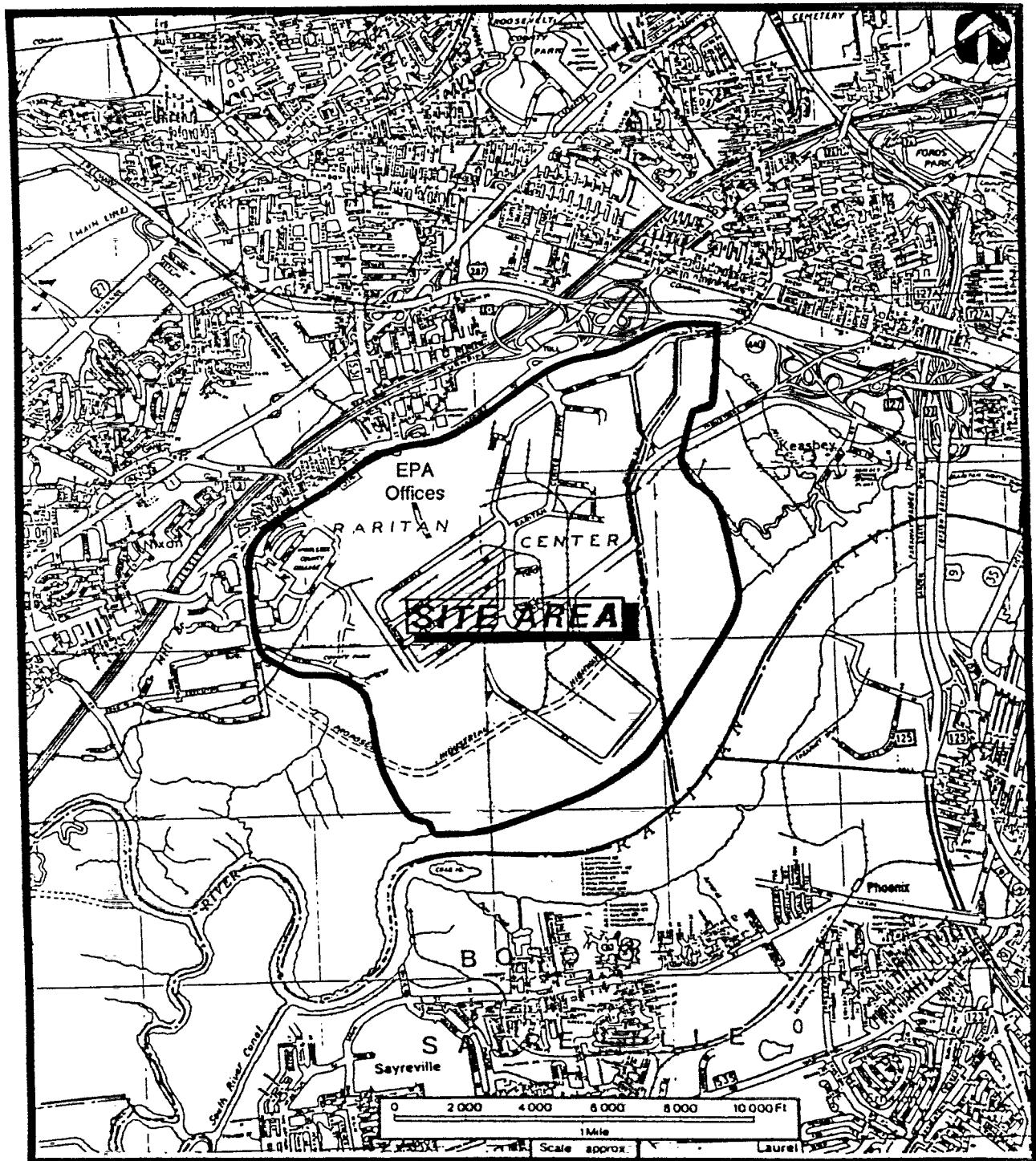
Through the characterizations we can provide a sound engineering evaluation and cost analysis (EECA) which will justify any further action (or inaction) that we take at each area. Up till now our priorities for cleanup of the individual areas have been based first on risk and next on public perception of risk. Through the EECA process we will involve the public in the decision-making process, which may involve their acceptance of some risk in order to keep costs down.

We have been asked at the public meetings if we will provide certification that the former arsenal is 100 percent cleared. Our reply has consistently been that we can never guarantee 100 percent clearance, but we will promise to clear all ordnance detectable using best available technology.

The ordnance removal at Raritan is the first such action attempted by the COE at this type of site. It has proven to be a site rich in surprises and learning experiences. We have discovered much more ordnance than we ever expected, and as a result our expectations of finding more ordnance have increased greatly. Our actions at Raritan will set a precedent for cleanups at former ordnance plants and arsenals throughout the United States. We must therefore take special care to conduct this cleanup in a sound professional manner.

U.S. Army Corps of Engineers Former Raritan Arsenal

Site Location Map



Source: Taken from Hagstrom Map:
Middlesex County, New Jersey, 1990

FIGURE 1